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DE-A- 2 302 887
FR-A- 2 205 630
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Description

This invention relates to a residual pressure control valve for incorporation in the high pressure fuel conduit extending between the pumping chamber of a high pressure fuel injection pump and an injection nozzle of a compression ignition engine, the nozzle incorporarting a spring loaded fuel pressure actuated valve member.

British Patent Specification 1511122 describes various forms of such a valve and the valve shown in Figure 8 comprises a hollow valve element which is biased into contact with an annular seating in one end wall of a cylinder by means of a coiled compression spring. Slidable within the valve element is a piston which extends from the valve element and is provided with a head. The head serves as an abutment for the spring and in the rest position of the valve with no pressure within the system, the head is engaged with the other end wall of the cylinder. The seating surrounds a port connected to the pumping chamber of the injection pump and the cylinder communicates with the inlet of the nozzle. In operation when fuel under pressure is delivered from the pumping chamber the valve element is lifted from the seating to allow fuel flow to the nozzle. When the flow of fuel from the pumping chamber ceases the valve element returns to its seating under the action of the spring and the valve of the nozzle closes. Some relief of the pressure in the conduit connecting the nozzle and the control valve will occur before the valve element closes and the pressure in the conduit will be further relieved by movement of the piston against the action of the spring. As the injection pressure is increased the stroke of the plunger will have to be increased in order to achieve a stable given residual pressure in the conduit. Increasing the stroke of the plunger besides requiring an increase in the volume of the cylinder which in itself is disadvantageous, also presents problems so far as the design of the spring is concerned.

DE-A-2302887 discloses a residual pressure control valve in which the valve element which is opened against the action of a spring to allow fuel flow from the injection pump to an injection nozzle, mounts a relief valve which opens to allow excess pressure upstream of the control valve to return to the injection pump.

FR-A-2205630 shows a residual pressure control valve having a valve member biased to the closed position by a spring and movable against the action of the spring to lift the valve member from a seating when the pumping plunger of the associated pump displaces fuel. The valve member carries a back pressure relief valve which is biased by a further spring into engagement with a seating defined on the valve member, the further spring being interposed between the relief valve and a body part of the control valve. The relief valve opens following delivery of fuel to depressurise the conduit connecting the control valve with the injection nozzle.

The object of the invention is to provide a residual pressure control valve for the pumping system in a simple and convenient form.

According to the invention a residual pressure control valve for incorporation in the high pressure fuel conduit extending between the pumping chamber of a high pressure fuel injection pump and a fuel injection nozzle, the latter incorporating a spring loaded fuel pressure actuated valve member comprises a cylinder having one end wall defining a seating surface about a port connected to the pump, an outlet from said cylinder connected in use to said nozzle, an annular valve element movable in the cylinder, a spring biasing the valve element into contact with the seating surface, a piston slidable in a bore defined in the valve element, said piston being resiliently biased away from said one end of the cylinder, the end of the piston remote from the one end wall being exposed to the pressure in the outlet from said cylinder, valve means defined by said valve element and said piston, said valve means being operable to connect said port with said outlet after a predetermined movement of the piston relative to the valve element against the action of its resilient loading and a stop to limit the movement of the piston under the action of its resilient loading characterised in that said stop is defined by the end wall of the cylinder opposite to said one end wall or by a part located against said end wall, and said piston is independently movable with respect to said valve element to control the residual pressure in said outlet following closure of the valve element onto the seating surface.

An example of a pressure control valve in accordance with the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is part sectional side elevation of the valve shown in the rest position and also illustrating the connection of the valve to the pumping chamber of an injection pump and to an injection nozzle,

Figure 2 shows the valve in the equilibrium position, and

Figures 3 and 4 are similar to figures 1 and 2 respectively but show a modified construction.

Referring to the drawings the residual pressure control valve generally indicated at 10, is connected between the pumping chamber of an injection pump 11 and a fuel injection nozzle 12 the valve in the particular instance being located in the body of the injection pump and being connected to

the injection nozzle by way of a conduit 13.

The valve 10 comprises a cylinder 14 one end wall of which defines an annular seating 15 about a port 16 connected to the pumping chamber of the injection pump. Slidable within the cylinder is an annular valve element 17 one end of which is shaped for co-operation with the seating. The valve element defines a step for engagement by a coiled compression spring 18, the spring acting to urge the valve element into contact with the seating.

Slidable within the valve element is a piston 19 having a head 20 which defines a flange for engagement by the spring 18. The head has a domed end engageable with the other end wall of the cylinder opposite to that in which the port 16 is formed.

The conduit 13 is connected to a port formed in the side wall of the cylinder and in operation when fuel under pressure is delivered from the pumping chamber of the injection pump the valve element 17 is lifted from its seating to permit fuel flow through the conduit 13 to the injection nozzle, the spring 18 being compressed. When the delivery of fuel by the injection pump ceases the valve element returns under the action of the spring 18 into contact with the seating 15 and before such sealing contact is established, a small quantity of fuel will return from the conduit 13 to the pumping chamber of the injection pump. When the valve element is in contact with the seating the pressure in the cylinder 14 which is equal to that in the conduit 13, acts upon the piston to move the piston downwardly and the piston will assume a position with its domed end spaced from the other end wall of the cylinder. The pressure within the cylinder and the conduit depends upon the strength of the spring, the area of the piston and the pressure in the conduit is controlled at a predetermined value. Where the injection pressure is extremely high the stroke of the piston would have to be increased to achieve the same residual pressure and as previously described, this can pose problems in the design of the valve. For example whilst it is possible to increase the stroke of the piston this does necessitate a larger volume for the cylinder and it also increases the stress in the spring 18. Moreover, when the valve member in the injection nozzle closes pressure pulses will be transmitted along the conduit 13 towards the cylinder and they may be of sufficient magnitude to cause the piston to move downwardly against the action of the spring, such further movement substantially increasing the stress in the spring.

In order to avoid such additional movement, the valve element is provided with a plurality of ports 21 which during the movement of the piston against the action of the spring are uncovered to a groove 22 formed in the periphery of the piston and communicating by way of a central drilling 23, with the port 16. The arrangement is such that during the relative movement of the valve element and piston against the action of the spring, the groove 22 will move into register with the ports 21 to place the conduit 13 in communication with the port 16 by way of the drilling 23 as shown in Figure 2. The fuel returned from the conduit can therefore flow directly to the pumping chamber of the injection pump and when the pressure in the conduit has fallen by a sufficient amount, the piston will move upwardly under the action of the spring to an equilibrium position in which the ports 21 are just closed by the piston. Excessive movement of the piston is therefore prevented with a consequent reduction in the stress applied to the spring 18 and without the need to increase the stroke of the piston.

In the arrangement shown in Figures 3 and 4 identical reference numbers are used wherever possible to those of Figures 1 and 2. The main difference between the two constructions is that the piston 19 is provided with a separate spring 24 to bias it away from the end wall of the cylinder 14 from which extends the port 16. As a result the piston 19 is separate from a spring abutment 25 for the spring 18. The abutment 25 is engaged by the piston as shown in Figure 3 to determine the extent of movement of the piston. As in the example of Figures 1 and 2 the piston is provided with a circumferential groove 22 which communicates with the port 16 by way of a central drilling 23. The mode of operation is exactly the same as previously described. This example has the advantage that the effective mass of the piston is reduced by the fact that it is not coupled to the abutment. Moreover, although two springs are employed in the design it is possible to choose springs appropriate to the delivery valve function and the unloading function.

Claims

1. A residual pressure control valve for incorporation in the high pressure fuel conduit extending between the pumping chamber of a high pressure fuel injection pump (11) and a fuel injection nozzle (12) the latter incorporating a spring loaded fuel pressure actuated valve member, the control valve comprising a cylinder (14) having one end wall defining a seating surface (15) about a port (16) connected to the pump (11), an outlet from said cylinder connected in use to said nozzle (12), an annular valve element (17) movable in the cylinder, a spring (18) biasing the valve element (17) into contact with the seating surface (15), a piston (19, 23) slidable in a bore de-

fined in the valve element, said piston being resiliently biased away from said one end wall of the cylinder, the end of the piston remote from the one end wall being exposed to the pressure in the outlet from said cylinder, valve means (21, 22) defined by said valve element (17) and said piston (19, 23) said valve means being operable to connect said port (16) with said outlet after a predetermined movement of the piston (19) relative to the valve element (17) against the action of its resilient loading and a stop to limit the movement of the piston (19, 23) under the action of its resilient loading characterised in that said stop is defined by the end wall of the cylinder opposite to said one end wall or by a part (25) located against said end wall, and said piston (19, 23) is independently movable with respect to said valve element (17) to control the residual pressure in said outlet following closure of the valve element (17) onto the seating surface (16).

2. A control valve according to Claim 1 characterised in that said valve means comprises a groove (22) on said piston (23), passage means (23) connecting said groove with said port (16) and a port (21) in said valve element (17).

3. A control valve according to Claim 2 characterised in that said piston (23) is provided with a head (20) and said spring (18) is located between said head (20) and the valve element (17).

4. A control valve according to Claim 2 characterised by a spring (24) interposed between said piston (19) and said one end wall of the cylinder.

Patentansprüche

1. Restdrucksteuerventil zum Einsetzen in die sich zwischen der Pumpenkammer einer Hochdruckkraftstoffeinspritzpumpe (11) und einer Kraftstoffeinspritzdüse (12) erstreckenden Hochdruckkraftstoffleitung, wobei die Düse ein federgespanntes, kraftstoffdruckbetriebenes Ventilteil enthält, mit einem Zylinder (14) mit einer Endwand, die eine Sitzoberfläche (15) um eine mit der Pumpe (11) verbundene Öffnung (16) definiert, einem bei der Benutzung mit der Düse (12) verbundenen Auslaß von dem Zylinder, einem in dem Zylinder bewegbaren, ringförmigen Ventilelement (17), einer das Ventilelement (17) in Kontakt mit der Sitzoberfläche (15) vorspannenden Feder (18), einem verschiebbar in einer in dem Ventilelement abgegrenzten Bohrung vorgesehenen Kolben (19, 23), wobei der Kolben federnd von der einen Endwand des Zylinders weg vorgespannt ist und das von der einen Endwand entfernte Ende des Kolbens dem Druck in dem Auslaß von dem Zylinder ausgesetzt ist, einer durch das Ventilelement (17) und durch den Kolben (19, 23) definierten Ventilvorrichtung (21, 22), wobei die Ventilvorrichtung zum Verbinden der Öffnung (16) mit dem Auslaß nach einer vorbestimmten Bewegung des Kolbens (19) relativ zu dem Ventilteil (17) gegen die Wirkung ihrer federnden Vorspannung und einen Anschlag zum Begrenzen der Bewegung des Kolbens (19, 23) unter der Wirkung seiner federnden Vorspannung betreibbar ist,
dadurch gekennzeichnet, daß der Anschlag durch die Endwand des Zylinders gegenüber der einen Endwand oder durch ein Teil (25), das gegen die Endwand angeordnet ist, definiert ist und daß der Kolben (19, 23) unabhängig bewegbar ist in Bezug auf das Ventilelement (17) zum Steuern des Restdruckes in dem Auslaß auf das Schließen hin des Ventilelementes (17) auf die Sitzoberfläche (16).

2. Steuerventil nach Anspruch 1,
dadurch gekennzeichnet, daß die Ventilvorrichtung eine Rille (22) auf dem Kolben (23), eine Durchgangsvorrichtung (23), die die Rille mit der Öffnung (16) verbindet und eine Öffnung (21) in dem Ventilelement (17) aufweist.

3. Steuerventil nach Anspruch 2,
dadurch gekennzeichnet, daß der Kolben (23) mit einem Kopf (20) versehen ist und daß die Feder (18) zwischen dem Kopf (20) und dem Ventilelement (17) angeordnet ist.

4. Steuerventil nach Anspruch 2,
gekennzeichnet durch eine zwischen dem Kolben (19) und der einen Endwand des Zylinders vorgesehenen Feder (24).

Revendications

1. Soupape de réglage de pression résiduelle pour incorporation dans le conduit de carburant sous haute pression s'étendant entre la chambre de pompage d'une pompe d'injection de carburant sous haute pression (11) et un injecteur de carburant (12), ce dernier englobant un organe de soupape sollicité par un ressort et entraîné par la pression exercée par le carburant, la soupape de réglage comprenant un cylindre (14) muni d'une première paroi terminale définissant une surface de siè-

ge (15) autour d'un orifice (16) relié à la pompe (11), une sortie dudit cylindre reliée lors de la mise en service audit injecteur (12), un élément de soupape annulaire (17) mobile dans le cylindre, un ressort (18) procurant à un élément de soupape (17) une précontrainte pour qu'il vienne se mettre en contact avec la surface de siège (15), un piston (19, 23) apte à coulisser dans un alésage défini dans l'élément de soupape, ledit piston étant mis en état de précontrainte de manière résiliente à l'écart de ladite première paroi terminale du cylindre, l'extrémité du piston éloignée de la première paroi terminale étant exposée à la pression régnant dans la sortie dudit cylindre, des moyens de soupape (21, 22) définis par ledit élément de soupape (17) et ledit piston (19, 23), lesdits moyens de soupape étant aptes à être mis en service pour relier ledit orifice (16) à ladite sortie après un mouvement prédéterminé du piston (19) par rapport à l'élément de soupape (17) à l'encontre de l'action de sa sollicitation résiliente, ainsi qu'un arrêt destiné à limiter le mouvement du piston (19, 23) sous l'action de sa sollicitation résiliente, caractérisé en ce que ledit arrêt est défini par la paroi terminale du cylindre opposée à ladite première paroi terminale ou bien par un élément (25) disposé contre ladite paroi terminale, et ledit piston (19, 23) est mobile, de manière indépendante, par rapport audit élément de soupape (17) pour régler la pression résiduelle régnant dans ladite sortie après la fermeture de l'élément de soupape (17) qui vient se disposer contre la surface de siège (16).

2. Soupape de réglage selon la revendication 1, caractérisé en ce que ledit moyen de soupape comprend une rainure (22) sur ledit piston (23), un moyen de passage (23) reliant ladite rainure audit orifice (16), ainsi qu'un orifice (21) pratiqué dans ledit élément de soupape (17).

3. Soupape de réglage selon la revendication 2, caractérisé en ce que ledit piston (23) est équipé d'une tête (20) et ledit ressort (18) est disposé entre ladite tête (20) et l'élément de soupape (17).

4. Soupape de réglage selon la revendication 2, caractérisé par un ressort (24) intercalé entre ledit piston (19) et ladite première paroi terminale du cylindre.

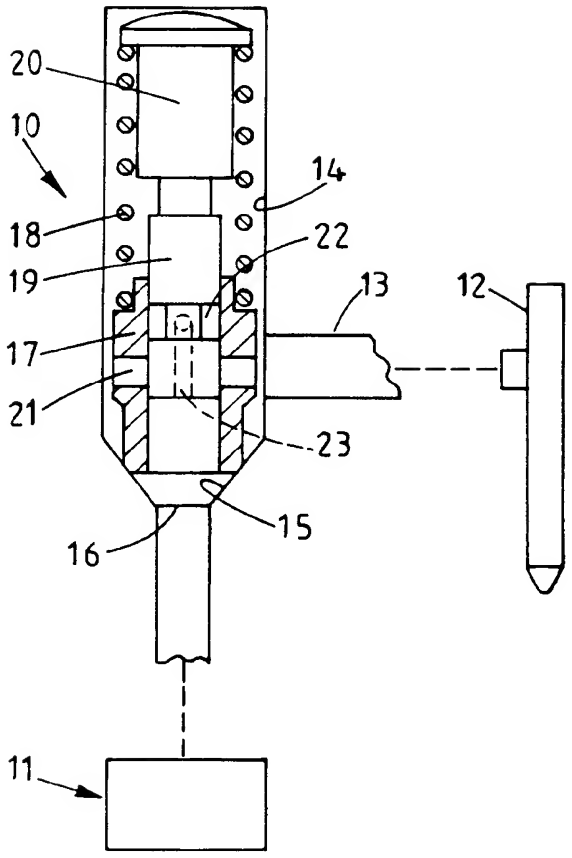

FIG.1.

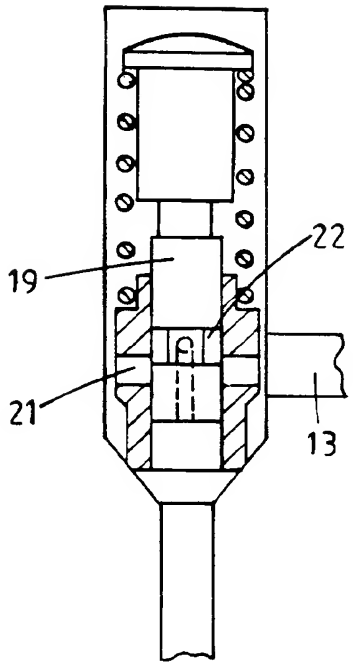

FIG.2.

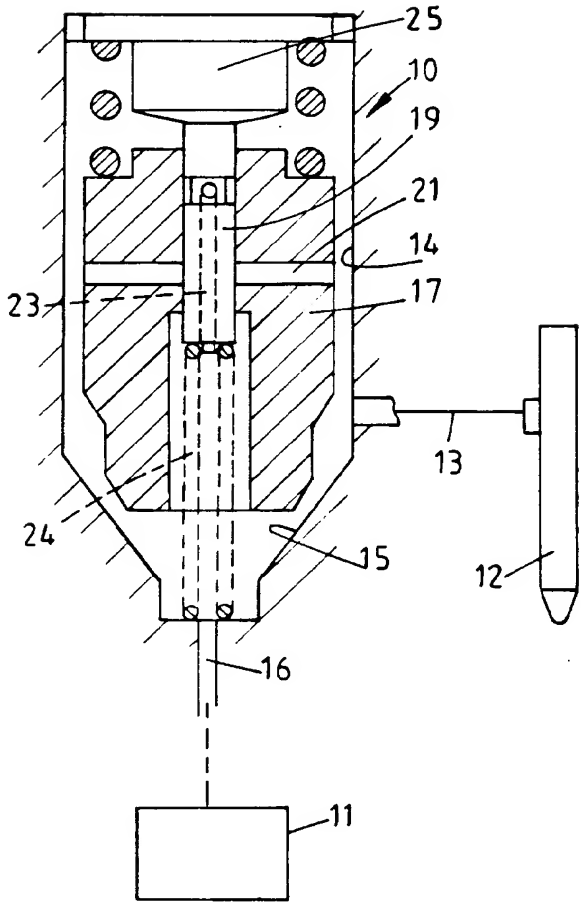

FIG.3.

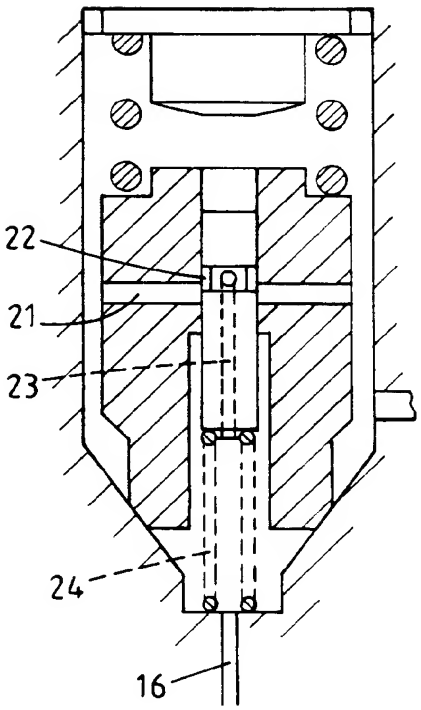

FIG.4.